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Mc CEA 3322

Monsanto

FROM (NAME—LOCATION—PHONE) J. Peduzzi - W.G.K. Plant

DATE Dec. 12, 1978

CC

SUBJECT CEA 3322 - MCB BENZENE REDUCTION INTERIM COMPLIANCE

REFERENCE

MCB Benzene Reduction Interim Compliance, 12-12-78

TO :

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As a result of the interim guidelines for benzene exposure levels of a 10 ppm TWA, 5 ppm action level and 20 ppm ceiling level, Project CEA 3322, MCB Benzene Reduction, has been reviewed to determine if the project should be modified. My recommendation is to delete the following items.

1)	Pump Seals and Sealless Pumps	$ 650,000
2)	Vent Header System	1,740,000
3)	Emergency Vent System	
4)	Ambient Air Monitoring	410,000
5)	Spare Pumps Except for Wet Benzene Pump	140,000
	Total Deletions	$2,940,000

We should proceed with the following portions of the project to comply with the interim guidelines.

1)	Sampling Devices	$ 110,000
2)	Pigging Stations	50,000
3)	Truck Unloading	30,000
4)	Car Unloading	30,000
5)	Breathing Air System	440,000
6)	Control Room Expansion	500,000
7)	Decontamination System	590,000
8)	Paving and Curbing	390,000
9)	Sewer Traps	570,000
10)	Spare Wet Benzene Pump	20,000
	Total Remaining Parts of Project	$2,730,000

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The following additions and modifications should be included in the revised project.

1) The existing emergency vent catch tank design must be confirmed as adequate to retain any liquid emissions and all department rupture discs will vent to catch tanks.

2) Two sealless pumps will be installed in severe service to gain experience with sealless pumps for possible future applications.

The costs presented are order of magnitude accuracy.

A detailed analysis of the individual project portions is attached.

John Peduzzi

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December 12, 1978

CEA 3322 - MCB BENZENE REDUCTION
INTERIM GUIDELINE COMPLIANCE

Monsanto's Department of Medicine and Environmental Health has issued an interim guideline for controlling benzene exposures following the U.S. Fifth District Court's decision to strike down the OSHA benzene standard. These guidelines are:

Action Level - 5 ppm
8-Hour Time Weighted Average (TWA) - 10 ppm
Ceiling Level - 20 ppm

Project CEA 3322, MCB Benzene Reduction, was developed to meet the OSHA standard of a TWA of 1 ppm. The following is a detailed analysis of the various parts of the project and a recommendation of which items should be done to meet the interim guidelines.

The benzene levels in the MCB department average 2.6 ppm based on 78 area samples taken from June, 1977 through December, 1977 (See Table III).

This is well below the action level of 5 ppm as defined by the interim guidelines. No further work is required to reduce the general background level of benzene; however, much of CEA 3322 deals with brief exposures above the ceiling level of 20 ppm. Most of these exposures are independent of each other and can be treated as individual problems.

Project CEA 3322 has been broken down into the following parts:

	Item	Approximate Cost
1)	Pump Seals & Sealless Pumps	$650,000
2)	Vent Header System	Combined Cost
3)	Emergency Vent System	$1,740,000
4)	Spare Pumps	$160,000
5)	Control Building Expansion	$500,000
6)	Breathing Air System	$440,000
7)	Ambient Air Monitoring	$410,000
8)	Decontamination System	$590,000
9)	Paving and Curbing	$390,000
10)	Sewer Traps	$570,000
11)	Pigging Stations	$ 50,000
12)	Car Unloading	$ 30,000
13)	Truck Unloading	$ 30,000
14)	Sampling Devices	$110,000

The total project cost is estimated at $5.6 million. Each part will be discussed at length with a recommendation for future actions.

1) Pump Seals and Sealless Pumps

Fugitive leaks from pump seals were to be stopped by installing sealless pumps where feasible and double mechanical seals where sealless pumps were not suitable. This part of the project addresses the background benzene levels and will not be required to meet the interim guidelines.

Recommendation: Delete pump seals and sealless pumps from CEA 3322.

2) Vent Header System

The vents from the various storage tanks and equipment were to be collected and vented through a 100 ft. stack to provide sufficient dispersion to reduce the background exposure levels to less than 1 ppm benzene. As our background levels are in compliance with the interim guidelines this portion of the project will not be required.

Recommendation: Delete the vent header system from CEA 3322.

3) Emergency Vent System

All rupture discs from organic containing tanks and equipment were to be collected and vented through a 100 ft. stack to provide sufficient dispersion to reduce the ground level exposure to less than 1 ppm benzene.

Emissions from relief devices are expected only a few times a year (no more than 1/month) and the vapor from these emissions is expected to only briefly raise the department benzene concentrations by a few ppm. Under these conditions an emergency vent system would not be required. Possible liquid emissions from relief devices would, however, cause serious problems both from a safety and benzene exposure standpoint. The existing emergency relief catch tanks designs should be reviewed for adequate ability to retain any liquid emissions. All department relief devices do not now relieve to catch tanks and those that do not must be modified to ensure no liquid emissions to the atmosphere.

Recommendation: Delete the emergency vent system from CEA 3322. Add the proper containment of liquid emissions from emergency vents to the scope of project CEA 3322.

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4) Spare Pumps

Installed spare pumps were to be provided for every pump handling a benzene containing stream. The intent was to allow improved maintenance with no additional downtime. In this fashion one would not be forced to chose between tolerating a benzene exposure problem from poorly maintained pump seals or shutting down the department.

4) Spare Pumps (continued)

The estimated emission from a well maintained pump seal handling 100% benzene is 80 grams/hr. of benzene while a poorly maintained pump seal will emit 473 grams/hr.

Table I indicates the benzene concentrations that can be expected from these emissions at various wind velocities. A wind velocity of 1 mile per hr. is the minimum expected in the area. Under this condition a poorly maintained pump seal can give a benzene concentration of over 10 ppm up to 5 feet from the pump. Only one of the pumps requiring a spare is in continuous duty pumping 100% benzene. This is Item 152, the Wet Benzene Pump. The remaining pumps are in intermittent service or handle streams of 50% or less benzene. It would seem advisable to provide a spare for this one pump.

Since we may in the future need to proceed with sealless pumps or double mechanical seals, this spare pump would be an excellent place to obtain experience with a sealless pump in benzene service. Approximate cost is $20,000. In addition to clean organic streams such as the wet benzene feed, other more difficult to handle fluids are pumped in the MCB department. To gain added experience in severe service we should install two additional sealless pumps handling difficult streams containing solids and/or dissolved gases.

Recommendation: Install a sealless spare pump for the wet benzene pump. Delete remaining spare pumps from CEA 3322. Install 2 additional sealless pumps in severe service to gain sealless pump experience.

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5) Control Building Expansion

The control room expansion is to enlarge the motor control center to house the starters for the new equipment, remodel the laboratory, upgrade the lunchroom facility to meet existing OSHA standards, and to provide space to house an air monitoring system.

The laboratory remodeling consisted of installing a standard laboratory hood, sink, and bench to provide the facility with normal laboratory protective equipment. This work should proceed to minimize the risks of chemical exposures from laboratory work. The lunchroom upgrading is for safety considerations other than the benzene guidelines and will still be required. Some motor control center expansion will still be required and the expansion should be sized to meet anticipated future needs. The air monitor system space is a minor portion of the control room expansion and since it is likely that this system will be a future requirement we should include air monitoring space in the control room expansion.

The control room expansion will be required as defined by the existing project.

Recommendation: Proceed with the control room expansion as part of CEA 3322.

6) Breathing Air System

The breathing air system was not a benzene control device but was for personal protection to be worn when the benzene level was over 50 ppm. It was to be used during bad spills, emergencies, when initially opening equipment that has contained benzene, etc. It's use is not affected by the change from the OSHA proposal to the interim guidelines. This system should be installed.

Recommendation: Installation of the breathing air system should proceed as part of CEA 3322.

7) Ambient Air Monitoring

The air monitoring system was to accomplish several things. It provided a continuous monitoring of the entire MCB area and contained an alarm system to indicate when protective equipment was needed and what kind of protective equipment would be required. The proper use of the breathing air system would have to rely on spot measurements and judgment in the absence of this system.

The continuous monitoring provided an excellent tool for detecting and curing sources of benzene exposure throughout the department. It helped guarantee the proper functioning of the benzene control systems.

There was also some anticipation that EPA would require continuous monitoring.

With the interim guidelines permitting a higher benzene level than OSHA's standard the monitoring task is less difficult. Also, since fewer benzene control systems will be required, the continuous monitoring system is not required to guarantee their proper functioning.

Recommendations: Delete the ambient air monitoring system from CEA 3322.

8) Decontamination System

The decontamination system was to be designed to prevent exposures when opening equipment for maintenance and inspections. This is especially significant during the semi-annual turnarounds. Table IV lists the exposures measured during the October, 1978 turnaround. TWA samples of both the area and personal samples averaged 11 ppm. Several TWA samples were over 30 ppm.

Table II of the appendix quantifies the costs and benefits of the various control measures. Using the exposure level, frequency of exposure, number of people exposed and cost of control, a cost of control in dollars per (manhour)(ppm benzene) per week was developed.

8) Decontamination System (contd.)

For the purpose of this cost benefit study the decontamination system, paving and curbing, and sewer traps were lumped into one group. This group has a $/manhr. ppm/week of 5326, making this group the most expensive of the control measures.

The decontamination system consists of a below grade closed collection system for liquids, an overhead system for vapor collection and an inert gas distribution system for purging of equipment. Drains and purge connections were to be installed as required to ensure good decontamination.

It is possible that with small plant projects and developing better procedures over a several year span that exposures on turnarounds could be reduced but it is unlikely that even the 20 ppm ceiling level can be met at all times without the full decontamination system.

Recommendation: Proceed with the decontamination system as part of CEA 3322.

9) Paving and Curbing

Paving and curbing was to be installed in those areas where benzene leaks were likely to occur. This included the column area, chlorination area and HCl gas cooling area. The intent was to provide rapid easy clean up of any benzene spills or leaks that would occur. Currently, these areas are chat or deteriorated concrete and they hold puddles of spills for a considerable time after the spill occurs. People are always exposed under these conditions as they will be in the immediate area dealing with the problem or cleaning up the spill.

Figure I in the Appendix shows the exposure possible from a benzene spill of 1 $ft.^2$. Under stagnant wind conditions of 1 mile per hour wind speed, a spill of less than 3 $ft.^2$ will exceed the 20 ppm ceiling limit within 5 ft. of the spill.

Table II in the Appendix quantifies the costs and benefits to be obtained from the various control measures. Paving and curbing, decontamination system and sewer traps are included as a single item. They result in a $5326/manhour ppm/week cost for control.

Paving and curbing must not be considered to be totally independent of the decontamination portion of the project. A major portion of the decontamination system will be the installation of a below grade enclosed collection system. Installing this system will necessitate extensive excavating and repaving. If the decontamination system is installed it is logical to install the paving and curbing also.

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9) Paving and Curbing (contd.)

Paving and curbing should definitely not be installed without first installing the below grade decontamination system. Much of the paving and curbing would be destroyed during a subsequent installation of the decontamination system.

Recommendation: Paving and curbing should proceed as part of CEA 3322. Install only if the decontamination system is installed.

10) Sewer Traps

The department currently has a benzene sewer trap that is a light organic phase/water separator. The trap was installed to keep floating organics out of the sewer to prevent the sewer vapor space from entering the flammable region. Heavy organics, however, that may contain as much as 50% benzene, go out of the trap with the water phase.

Organics enter the sewer only from spills, leaks, equipment cleanouts, sample disposal, etc. It is probable that the heavy organic phase containing benzene will cause the sewer vents to occasionally have a benzene concentration of several ppm.

While it is not anticipated that the sewer vents would exceed the 20 ppm ceiling level, the sewer system would give a benzene exposure through much of the plant and at the waste treatment facility.

The installation of a decontamination system and paving and curbing to allow faster and better draining of organics to the sewer will intensify the need for a sewer trap system. During turnarounds as much as 2000 gallons of organics would be sewered. It is also likely that the current benzene trap would not handle the total light organic phase during a turnaround causing high benzene exposures and/or explosions from a floating benzene layer.

It is environmentally unsound to sewer such a high level of organics and the sewer trap system should be installed to recover or provide safe disposal of the free organics entering the sewer.

Due to the close relationship between the sewer traps and the paving and curbing and decontamination system these items are listed as one control measure in the cost benefit analysis shown in Table II.

Recommendation: Proceed with sewer traps as part of CEA 3322.

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11) Pigging Stations

Frequent high level exposures occur when pigging the benzene transfer line from the river terminal to Big Mo. Pigging occurs twice a week with exposures of up to 100 ppm.

Table II quantifies the costs and benefits of controlling this exposure at $735/man hr. ppm/week.

The mechanism for control has not yet been specified. CEA 3322 contained $50,000 in undeveloped design to control benzene emissions in this area. It is probable that an enclosure such as a glove box will be used.

Pigging station control will eliminate a significant repetitive benzene exposure for a relatively small expenditure.

Recommendation: Proceed with pigging station control as part of CEA 3322.

12) Car Unloading

The prime benzene supply for MCB comes by barge and is transferred by pipeline to the department. In the event of failure of this supply route, river conditions, barge availability, etc. benzene is brought in by tank car and unloaded at two docks in the MCB department.

Unloading of tank cars occurs infrequently but significant exposures result when this operation takes place. The unloader may receive up to 100 ppm of benzene for 1½ hrs. per car with five cars per day unloaded.

We make every attempt to use only barge benzene but it is inevitable that tank cars will be required on occasion. Tank car unloading for four weeks a year was used in the cost benefit quantification shown in Table II. At $149/man hr. ppm/week controlling tank car unloading emissions is one of the most cost effective control measures.

The control system consists of a vent to the storage tanks, a tight dome cover seal and dripless disconnects. This system is not expected to reduce the exposure from this operation to less than 1 ppm but should cut the benzene concentration to less than 10 ppm.

Recommendation: Proceed with tank car unloading control as part of CEA 3322.

13) Truck Unloading

Unloading benzene from trucks occur only when both barge and tank car benzene are unavailable. Every attempt is made to use only barge benzene and as a second choice tank car benzene.

13) Truck Unloading (contd.)

Yet we are sure to be forced to use benzene delivered by trucks on rare occasions. I have estimated that this occurs for 2 weeks per year.

The benzene exposure from truck unloading is up to 100 ppm for 1½ hrs. per truck with 8 trucks unloaded per day. Table II quantifies the costs and benefits of controlling this exposure at $93/man hr. ppm/week. This is the most cost effective control item on the list.

The control system consists of dripless connectors and a vent. The exposure level is expected to be below 10 ppm but over 1 ppm after control.

Recommendation: Proceed with truck unloading control as part of CEA 3322.

14) Sampling Devices

The various routine samples taken in the department result in the most frequent operator exposure to high levels of benzene.

Benzene concentrations of 20 ppm or more occur during the sampling. With 14 samples taken each day the amount of operator exposure is significant.

The project proposed to control this exposure through the installation of non venting sampling devices at a cost of $110,000.

It is probable that independent plant activity can, through the use of dripless connectors or other methods, reduce this exposure to routinely below 20 ppm with only slight expense. This plant work will continue.

The cost benefit quantification in Table II is based on the $110,000 estimate. This control measure will cost $1700/man hr. ppm/week. The sampling exposure is close to the ceiling limit of 20 ppm and does not cause the operator personal samples to exceed the TWA of 10 ppm. However, given the frequency and relatively high benzene concentrations I feel that controlling this exposure is a must.

Recommendation: Proceed with sampling devices as part of CEA 3322.

TABLE I

CALCULATED EXPOSURE LEVELS

AT VARIOUS EMISSION RATES,

WIND VELOCITIES AND DISTANCES

FROM SOURCE

Emission Rate of 80 Grams Benzene per Hour

Wind Velocity Miles/Hr.	Benzene Concentration, PPM(V), at Distance from Source, Ft. 1.5	2.0	5.0	10.0	20.0	30.0
0.1	22.70	22.10	18.15	12.56	8.49	6.43
1.0	2.27	2.21	1.82	1.26	0.85	0.64
5.0	0.45	0.44	0.36	0.25	0.17	0.13
7.5	0.30	0.29	0.24	0.17	0.11	0.09
10.0	0.23	0.22	0.18	0.13	0.08	0.06

Emission Rate of 473 Grams Benzene per Hour

0.1	134.22	130.72	107.34	74.28	50.18	38.03
1.0	13.42	13.07	10.73	7.43	5.02	3.80
5.0	2.68	2.61	2.15	1.99	1.00	0.76
7.5	1.79	1.74	1.43	0.99	0.67	0.51
10.0	1.34	1.31	1.07	0.74	0.50	0.38

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TABLE II

BENZENE COST CONTROL AND BENEFITS

Source	Control Cost ($1000)	Exposure (ppm)	Exposure Time (hrs.)	No. People Exposed	Exposure Freq.	Manhrs. ppm/wk.	$/Manhours ppm/week
Pigging	50	100	0.17	2	2/week	68	735
Sampling	110	20	0.033	1	14/day	65	1692
Car Unloading	30	100	1.5	1	5/day 2 wk./yr.	202	149
Truck Unloading	30	100	1.5	1	8/day 2 wk./yr.	323	93
Sewer Traps Paving & Curbing Decontamination	1550						5326
A (Turnaround)		11	32	20	2/yr.	271	
B (Misc.)		11	8	2	6/yr.	20	

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TABLE III

DEPT. 233 (MCB) BACKGROUND BENZENE CONCENTRATIONS

Sample	Location*	Benzene Concentration ppm 6/77	7/77	8/77	10/77	11/77	12/77
2		0.5	0.1	0.3	1.0	11.6	3.6
3		0.5	6.8	0.4	0.6	1.4	1.8
4		0.1	4.8	0.3	2.0	1.0	1.4
5		0.6	18.0	8.5	1.0	0.6	0.3
6		0.4	18.2	8.5	0.6	1.2	1.2
7		0.6	3.8	2.5	1.4	0.8	5.5
8		2.8	8.4	0.9	0.7	0.5	1.2
9		1.6	2.9	0.4	1.6	0.4	0.7
10		0.4	1.4	0.3	4.6	0.0	1.4
11		0.6	0.7	0.3	1.4	1.8	1.1
12		0.5	0.7	0.0	1.4	0.2	0.3
13		--	--	--	0.2	0.1	0.3
14		--	--	--	0.4	32.9	5.6
15		--	--	--	0.4	0.2	0.1
16		--	--	--	0.3	---	0.3
Average		0.8	6.0	2.0	1.1	3.8	1.6

*See attached map (Figure II) for location of sample points.

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TABLE IV

BENZENE CONCENTRATIONS DURING TURNAROUND

Area Samples

Location*	Description	ppm Benzene
1	Control Room	1.3
2	E. of Control Room Door	10.8
3	Hose Rack S. of Chlorinators	2.3
5	S. End of Chlorinators	18.7
6	10' Level at SE End of Air Cooler	0.5
8	N. End of Chlorinators	39.3
9	Starter box for Ammonia Compressor	11.4
12	W. of Carbon Towers	1.0
	Average	10.7

Personal Samples

Sample	PPM Benzene	Sample	PPM Benzene	Sample	PPM Benzene
1	9.7	11	35	21	22
2	13.5	12	3.1	22	5.3
3	6.9	13	57.8	23	5.6
4	13.3	14	0.9	Average	10.9
5	7.0	15	5.3		
6	1.6	16	0.9		
7	2.8	17	7.2		
8	0.6	18	3.1		
9	36	19	4.0		
10	8.1	20	0.8		

*See Figure II for sample locations.

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FIGURE I

MAXIMUM DOWNWIND CONCENTRATIONS FROM A SPILL OF PURE BENZENE

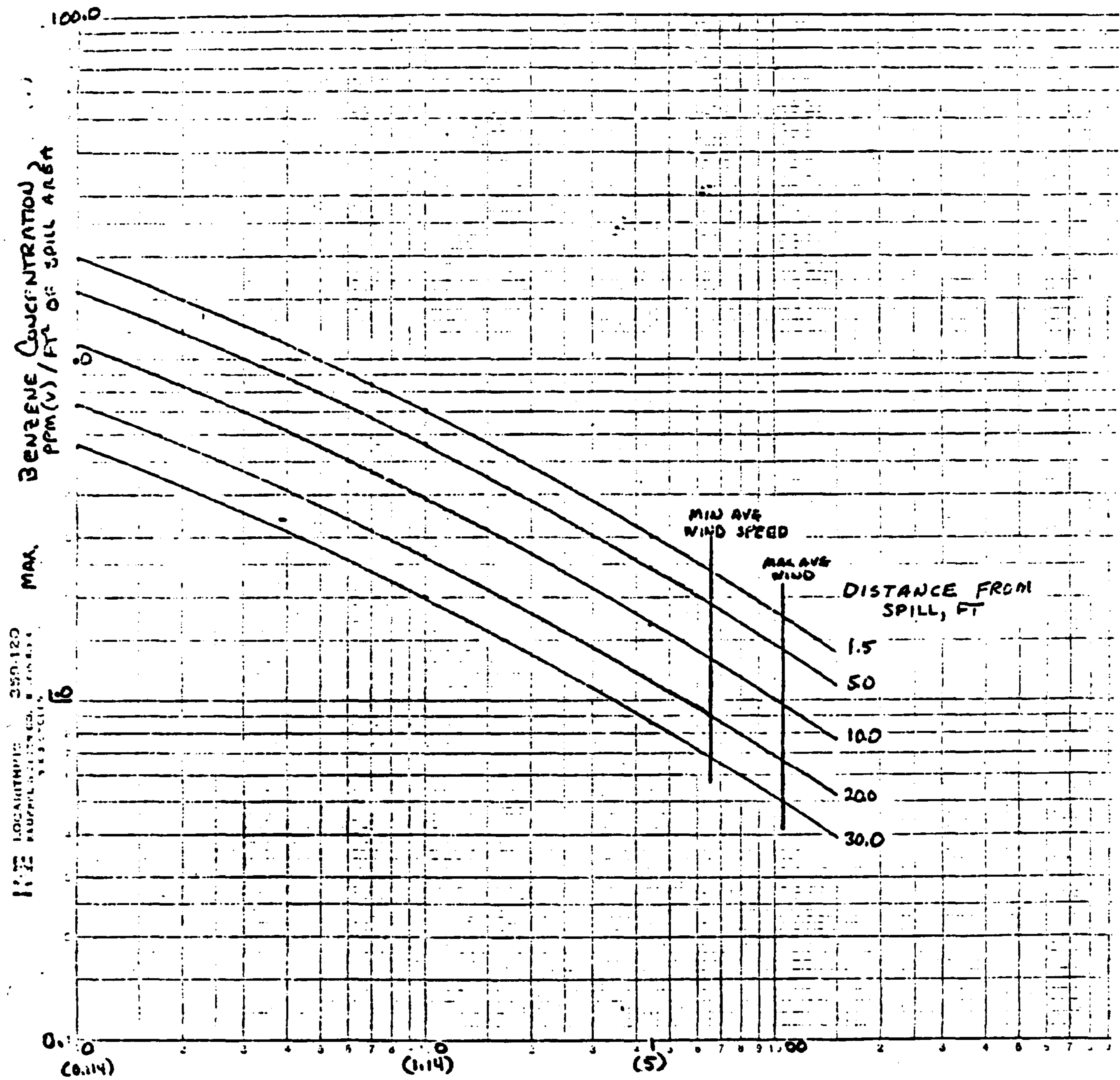

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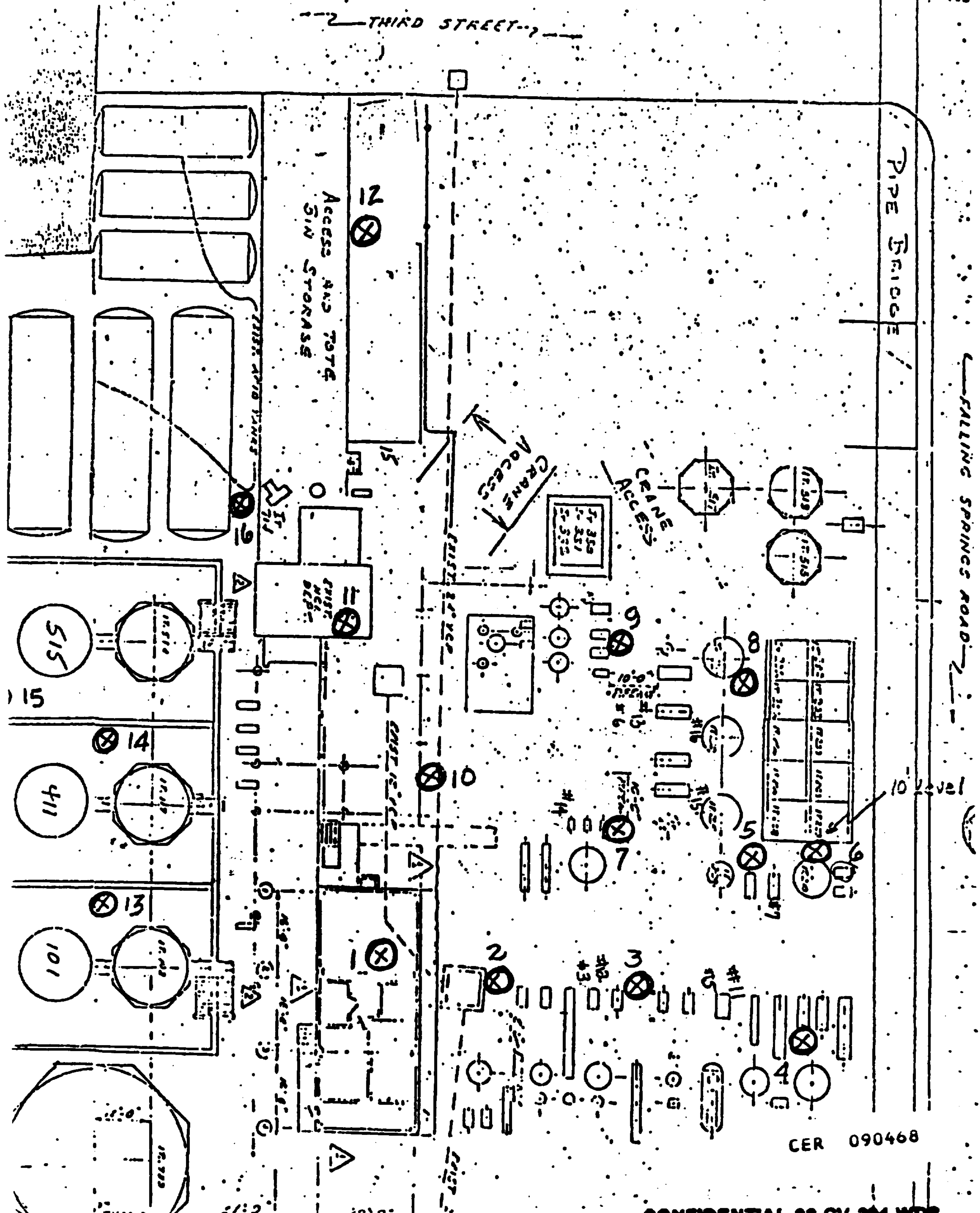
FIGURE II MCB DEPT SAMPLE LOCATIONS



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